$y = x \ln x - x$

$y' = \cancel{x \cdot \frac{1}{x}} + \ln x \cdot 1 - \cancel{1}$

$y' = \ln x$

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$y = \sqrt[5]{\frac{(x-3)^4(x^2+1)}{(2x+5)^3}}$

$\ln y = \ln \sqrt[5]{}$

$\ln y = \frac{4}{5}\ln(x-3) + \frac{1}{5}\ln x^2+1 - \frac{3}{5}\ln(2x+5)$

$y' \cdot \frac{1}{y} \quad \frac{1}{x+3} \quad 2x \cdot \frac{1}{x^2+1} \quad \frac{1}{2x+5}$

$y' \cdot \frac{1}{y} \cdot \frac{y}{1}\left(\frac{4}{5x+15} + \frac{2x}{5x^2+5}\right) - \frac{6}{10x+25}\Big) \sqrt[5]{}$

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45. $\ln y = \ln\left[\sqrt[5]{\frac{(x-3)^4(x^2+1)}{(2x+1)^3}}\right]^{\frac{1}{5}}$

$\ln y = \frac{1}{5}\left[\ln(x-3)^4(x^2+1) - \ln(2x+1)^3\right]$

$\ln y = \frac{1}{5}\left(4\ln(x-3) + \ln(x^2+1) - 3\ln(2x+1)\right)$

$\cancel{\frac{1}{y}}\, y' = \frac{1}{5}\left[\frac{4}{x-3} + \frac{2x}{x^2+1} - \frac{6}{2x+1}\right] \sqrt[5]{(\ )}$

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24. $y = \frac{1}{\log_2 x}$

$y' = \frac{\log_2 x \cdot 0 - 1 \cdot \frac{1}{x\ln 2}}{(\log_2 x)^2} = \frac{\frac{-1}{x\ln 2}}{\left(\frac{\ln x}{\ln 2}\right)^2}$

$\log_2 x = \frac{\ln x}{\ln 2}$

$\frac{-1}{x\cancel{\ln 2}} \cdot \frac{(\ln 2)^{\cancel{2}}}{(\ln x)^2}$

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54. $\frac{d}{dx}\ln kx = \frac{1}{kx}\cdot k = \frac{1}{x}$

$\frac{d}{dx}\ln k + \ln x = 0 + \frac{1}{x}$

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$\frac{d}{dx}u^n = n u^{n-1}\frac{du}{dx}$ power rule

$\frac{d}{dx}k\cdot u = k\cdot\frac{du}{dx}$ constant multiple rule

$\frac{d}{dx}(u \pm v) = \frac{du}{dx} \pm \frac{dv}{dx}$ sum/difference rule

$\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}$ product rule

$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$ quotient rule

$\frac{d}{dx}f(g(x)) = g'(x)\cdot f'(g(x))$ chain rule

$\frac{dy}{dx} = \frac{dy}{du}\cdot\frac{du}{dx}$

$\frac{dy}{dx} = \frac{dy/dt}{dx/dt}$ chain rule for parametric equations

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trig functions

$\frac{d}{dx} \sin u = \cos u \frac{du}{dx}$

$\frac{d}{dx} \cos u = -\sin u \frac{du}{dx}$

$\frac{d}{dx} \tan u = \sec^2 u \frac{du}{dx}$

$\frac{d}{dx} \cot u = -\csc^2 u \frac{du}{dx}$

$\frac{d}{dx} \sec u = \sec u \tan u \frac{du}{dx}$

$\frac{d}{dx} \csc u = -\csc u \cot u \frac{du}{dx}$

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inverse trig

$\frac{d}{dx} \sin^{-1} u = \frac{1}{\sqrt{1-u^2}} \frac{du}{dx}$

$\frac{d}{dx} \cos^{-1} u = \frac{-1}{\sqrt{1-u^2}} \frac{du}{dx}$

$\frac{d}{dx} \tan^{-1} u = \frac{1}{1+u^2} \frac{du}{dx}$

$\frac{d}{dx} \cot^{-1} u = \frac{-1}{1+u^2} \frac{du}{dx}$

$\frac{d}{dx} \sec^{-1} u = \frac{1}{|u|\sqrt{u^2-1}} \frac{du}{dx}$

$\frac{d}{dx} \csc^{-1} u = \frac{-1}{|u|\sqrt{u^2-1}} \frac{du}{dx}$

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exponential

$\frac{d}{dx} e^u = e^u \frac{du}{dx}$

$\frac{d}{dx} a^u = a^u \ln a \frac{du}{dx}$

logarithms

$\frac{d}{dx} \ln u = \frac{1}{u} \frac{du}{dx}$

$\frac{d}{dx} \log_a u = \frac{1}{u \ln a} \frac{du}{dx}$

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implicit differentiation

1. take der of both sides term by term. (don't forget product rule, chain rule)
2. solve for y'

logarithmic differentiation

1. take ln of both sides
2. simplify using properties of ln
3. implicit diff.
4. substitute for y

use if x's in both the base & exponent

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